

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and Indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) U.S. ARMY TEST & EVALUATION COMMAND ABERDEEN PROVING GROUND, MD 21005		2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED
		2b. GROUP -----
3. REPORT TITLE U.S. Army Test & Evaluation Command Common Engineering Test Procedure Materiel Thst Procedure 7-2-506 "Airdrop Systems Safety"		
4. DESCRIPTIVE NOTES (Type of report and inclusive dates; Final)		
5. AUTHOR(S) (First name, middle initial, last name) -----		
6. REPORT DATE 15 February 1972	7a. TOTAL NO. OF PAGES 24	7b. NO. OF REFS 18
8a. CONTRACT OR GRANT NO.	8b. ORIGINATOR'S REPORT NUMBER(S) MTP 7-2-506	
9a. PROJECT NO. AMCR 310-6	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited		
11. SUPPLEMENTARY NOTES -----	12. SPONSORING MILITARY ACTIVITY Headquarters U.S. Army Test & Evaluation Command Aberdeen Proving Ground, Md 21005	
13. ABSTRACT Describes a method for evaluation of airdrop equipment safety characteristics. Provides procedures for test preparation, initial inspection, preparation of questionnaires, mechanical hazards, electrical hazards, personnel safeguards, and safety measures required on drop zone (land and water). Appendices describe permanently installed airdrop equipment, identify the levels of safety hazards, and provide an example questionnaire. Applicable to airdrop equipment (restraining, extraction, retardation, and ground impact) for rotary and fixed wing aircraft in the delivery of general materiel, excluding toxic or hazardous items.		

Reproduced by
**NATIONAL TECHNICAL
INFORMATION SERVICE**
 Springfield, Va 22151

DD FORM 1 NOV 68 1473
REPLACES DD FORM 1473, 1 JAN 64, WHICH IS
OBSOLETE FOR ARMY USE.

UNCLASSIFIED

Security Classification

~~UNCLASSIFIED~~
Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Airdrop operations						
Safety						
Airdrop Capability (or Airdropability)						

~~UNCLASSIFIED~~
Security Classification

15 February 1972

Materiel Test Procedure 7-2-506
Yuma Proving Ground

U. S. ARMY TEST AND EVALUATION COMMAND
COMMON ENGINEERING TEST PROCEDURE

AIRDROP SYSTEMS SAFETY

1. OBJECTIVE

The objective of this Materiel Test Procedure is to describe the methods used in the examination of permanently installed airdrop equipment (Appendix A) to ensure that there are no inherent hazards. Airdrop equipment can be found on various Air Force and Army aircraft, both rotary and fixed wing type. Airdrop equipment should be evaluated as individual items and as a part of the entire system from rigging to recovery.

2. BACKGROUND

Safety, as defined in MIL-STD-882, is freedom from those conditions which can cause injury or death to personnel; damage to or loss of equipment or property.

The U. S. Army Test and Evaluation Command (TECOM) requires that all equipment undergoing engineering testing be accompanied with a Safety Statement in accordance with TECOM Regulation 385-6 (Verification of Safety of Materiel During Testing), as evidence that the equipment is safe for testing. During engineering testing hazards may be disclosed which jeopardize the safety of the crew or the aircraft. These hazards may only be detectable during certain operational conditions and therefore require the cooperation of all personnel to identify these hazards during engineering testing.

This MTP is basically concerned with the various mechanical and electrical components which are permanently installed on the delivering aircraft. There are, however, additional procedures included which pertain to the safety measures required on the drop zone, both land and water.

3. REQUIRED EQUIPMENT

- a. Supporting aircraft and suitable airport facilities
- b. Test Item and Maintenance Package
- c. Test Instrumentation (multimeter, thermometers, windmeters, etc.)
- d. Measuring Tools (scale, tape, calipers, etc.)
- e. Weight Measuring Equipment
- f. Photographic Equipment (cameras, film and lights)
- g. Voice Tape Recorders
- h. Radio Communications Equipment
- i. Support Vehicles (Emergency and Recovery)
- j. Loading Vehicles (trucks, lifts, etc.)
- k. Smoke Grenades
- l. Warning Signs and Tags

4. REFERENCES

App	use;
Distribution Unlimited	



- A. Army Regulation 70-10, Research and Development; Test and Evaluation During Development and Acquisition of Materiel.
- B. Army Regulation 70-38, Research and Development; Research, Development, Test and Evaluation of Materiel for Extreme Climatic Conditions.
- C. Army Regulation 70-39, Research and Development; Criteria for Air Transport and Airdrop of Materiel.
- D. TECOM Regulation 70-23, Equipment Performance Report.
- E. TECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- F. AMC Regulation 385-12, Verification of Safety of Materiel from Development Through Testing, Production and Supply to Disposition.
- G. Yuma Proving Ground, Safety Regulations.
- H. USAMC Regulation 385-22, AMC Safety Manual.
- I. MIL-STD-669B, Loading Environment and Related Requirements for Platform Rigged Airdrop Materiel.
- J. MIL-STD-882, System Safety Program for Systems and Associated Subsystems and Equipment; Requirements for.
- K. MIL-STD-814B, Requirements for Tiedown Suspension and Extraction Provisions on Military Materiel for Airdrop.
- L. Technical Manual 38-250, Packaging and Handling of Dangerous Materiel for Transportation by Military Aircraft, with changes.
- M. Technical Manual 55-450-10/1, Standard Loads in U. S. Air Force C-130E Aircraft.
- N. Technical Manual 10-500 Series, Airdrop of Supplies and Equipment.
- O. U. S. Air Force T.O. 1C-130A-9, Technical Manual, Loading Instructions.
- P. United Underwriters, Inc., Standards for Safety.
- Q. Test Item, Safety Statement, Technical Manuals and other applicable publications.
- R. MTP 6-2-502, Human Factors Engineering.
- S. MTP 7-2-100, Tiedown Cargo Aircraft.
- T. MTP 7-2-510, Airdrop System Components.

5. SCOPE

In order to ensure effective safety testing, positive methods must be applied so that all test personnel are made fully aware of the importance of safety concepts and practices. Two concepts are used: the safety indoctrination and the safety questionnaire or checklist.

5.1 SUMMARY

5.1.1 Preparation for Test

This section consists of 1) a pretest inspection; 2) a safety indoctrination and 3) preparation of a "tailored" questionnaire for the particular

MTP 7-2-506
15 February 1972

test item and familiarization with it, and the standard questionnaire provided in the Appendix. The tailored questionnaire is made up to cover safety considerations peculiar to the test item and to exercise any safety devices emergency controls or alarms provided.

5.1.2 Test Conduct

This section describes the subtests to be performed and general procedures required to obtain the safety data for analysis.

a. Mechanical Hazards - The objective of this subtest is to determine if there are any mechanical hazards to personnel and equipment inherent in the physical design of the test item, and the adequacy of features designed to eliminate or minimize the hazards.

b. Electrical/Electronics Hazards - The objective of this subtest is to determine if there are any electrical hazards inherent in the design of the test item which could cause inadvertent activation of components or shock to personnel, and to evaluate the adequacy of features designed to eliminate these hazards.

c. Personnel Safeguards - The objective of this subtest is to determine if the design of the test item incorporates features to eliminate or minimize potentially hazardous conditions not classifiable as electrical or mechanical. These include such miscellaneous hazards as tripping or falling (inside the aircraft or outside the aircraft), thermal sources, and chemical contamination.

d. Safety Measures Required on the Drop Zone - The objective of this subtest is to determine those special safety provisions required at the drop zone to safely support the recovery of the test item.

5.1.3 Test Data

This section details the data to be collected. It will include the questionnaire forms shown in the Appendix. Test item hazards are categorized using the categories contained in MIL-STD-882. Appropriate measurements and photographs are also included in this section.

5.1.4 Data Reduction and Presentation

This section provides general guidelines for analyzing and evaluating the data from the subtests. The evaluation is based on a subjective analysis conducted within the framework of the four category "Analysis Guideline" shown in Appendix B.

5.2 LIMITATIONS

It would be ineffective to try to generate a detailed questionnaire to describe every possible hazard that might be encountered. Instead, the questionnaires in this procedure indicate particular areas to be considered for possible hazards. For this to be of maximum use test personnel must be thoroughly versed in safety practices and equally committed to safety principles. Both those who actually participate in the test conduct and those who prepare

MTP 7-2-506
15 February 1972

the test plan and questionnaires must have the required expertise and commitment. If possible test facility safety personnel should be available for direction and consultation during test conduct.

6. PROCEDURES

If other engineering tests are being conducted in conjunction with the safety test, as much as possible of the safety test should be conducted prior to the other test(s). In this way, hazards to test personnel and equipment can be reduced during the conduct of these other tests.

6.1 PREPARATION FOR TEST

6.1.1 Indoctrination

- a. Select test personnel and project officer/engineer who are thoroughly versed in safety procedures, safety regulations and safety criteria.
- b. Review the Safety Statement and note the safety features of the test item and the precautionary measures which must be observed during testing.
- c. Review all instruction manuals, QMR, SDR, TC, SOR, Test Directive and all other literature applicable to the test item to ensure that complete and suitable test criteria are selected.
- d. Study Appendix B to become familiar with the method of categorizing hazards.
- e. Brief all test personnel on the operational test plan and on methods to be employed in maintaining continuous observation of the test item during test phases to ensure that all hazards will be detected and identified.

6.1.2 Required Equipment/Facilities Setup

- a. Ensure that all tools and test equipment are readily available for operation, maintenance, or adjustment of the test item.
- b. Ensure that the required shops have been notified and schedules approved for inspection, rigging, and storage of the test item.
- c. Inspect all equipment and handling devices to ensure everything is in safe working order to support the test.
- d. Ensure that safety of flight releases have been requested from and provided to testing activities by U. S. Army Aviation Systems Command (AVSCOM) for tests of Army Aircraft Systems.
- e. Ensure that similar safety of flight releases have been provided for U. S. Air Force Aircraft Systems.
- f. Ensure that all operational support is available including aircraft, loading vehicles, drop zone, recovery vehicles, etc.

6.1.3 Receiving Inspection

- a. Examine test item for completeness, freedom from corrosion and dirt, freedom from shipping damage, etc. Submit an Equipment Performance Report (EPR) for each noted shortage or discrepancy in accordance with applicable procedures of TECOM Regulation 70-23.
- b. Record all nameplate identifying data.
- c. Examine all manuals and drawings for adequacy.

6.1.4 Preparation of Questionnaires

a. Study the standard questionnaire in Appendix C. All test personnel should be familiar with its contents so they are alert to its requirements at all times during test conduct.

b. Using the applicable test item literature, prepare a tailored questionnaire to be used in addition to the standard questionnaire. Use the standard questionnaire as a model. The tailored list should accomplish the following:

- 1) Check those areas which are peculiar to the test item and are not covered in the standard questionnaire.
- 2) Exercise all safety devices, emergency controls and alarms to ensure that they will operate when needed.
- 3) Ensure that all safety devices, emergency controls and alarms are properly adjusted.

c. The questionnaire should also include questions on human factors problems as related to Airdrop Systems. Refer to MTP 6-2-502.

6.2 TEST CONDUCT

The test item should be in good operating condition, in its normal configuration in accordance with applicable equipment technical manuals.

Since safety testing is normally integrated with other tests, care must be taken to ensure that the test item will be exercised through a range of conditions and operational modes to which it may be subjected in tactical use thereby increasing the possibility of discovering safety hazards. Refer to MTP 7-2-100 and 7-2-510.

6.2.1 Mechanical Hazards

a. In accordance with the appropriate U. S. Air Force Technical Order (T.O.) install the test item on the aircraft. Refer to T.O. applicable to test aircraft for general information on cargo equipment. TM-500 and TM-500-6 will be complied with when utilizing U. S. Army Aircraft.

b. Perform general checkout or maintenance procedures in accordance with the T.O.

c. Check appropriate answers on questionnaire sheets relative to installation of the test item. If the safety hazard presents a serious threat to personnel or the aircraft, a supplemental comment sheet should enumerate the safety hazards, and recommend a fix for the problem. Note any interrelationship between safety and human factors problems.

d. Photograph the test item and annotate the film to indicate any safety hazards.

e. Subject the test item to dynamic operational conditions:

- 1) Taxiing, takeoff and landing under loaded conditions
- 2) Release and extraction of load from aircraft
- 3) Retraction of lines and cables

f. Check appropriate answers on questionnaire sheets relative to operational conditions. Again, if a serious safety hazard exists fill out a supplemental comment sheet, recommending a fix, and noting the relationship between the safety and human factor problems.

g. Note any corrective action taken to reduce safety hazards during operational phases.

6.2.2 Electrical/Electronic Hazards

a. During installation, checkout and preflight operations, determine if there are any dangerous voltage or current levels at exposed points, by taking measurements at these exposed points and between equipment and the frame of the aircraft.

b. Determine if hazardous voltages, test points, etc., are properly identified and noted in instructional and operating procedures, schematics, and drawings.

c. Check appropriate answers on the questionnaire sheets. Note both the safety hazards and the human factors considerations, e.g., a faulty design may require the operator to place his hand close to a high electrical potential to reach a control.

d. During the air movement phase (taxiing, in flight, and airdrop) carefully monitor the operation of all equipments noting conditions which may cause shock to personnel or accidental activation of equipments.

e. Repeat Step c, above.

6.2.3 Personnel Safeguards

Many hazards exist that cannot be classed as mechanical or electrical but fall into a special category that encompasses miscellaneous hazards that could injure or kill personnel engaged in airdrop operations.

a. During loading operations note any hazards to personnel while they load cargo. This should include the manner in which the load is maneuvered into the aircraft, use of special handling and loading equipment, securing load in the aircraft, etc.

b. Check appropriate answers on questionnaire sheets, and prepare a comment sheet describing the hazards and recommended fixes.

c. During flight note hazards while moving around the aircraft especially those items that may cause tripping, or falls, e.g., metal support rods between dual-rail base and sides of aircraft; power cables and winch lines.

d. Just prior to the drop note hazards from opening of cargo doors and preliminary release of platforms. Normally the left hand latches are released six minutes prior to drop, and the load should remain stable with right hand latches and longitudinal cable secured. The last one minute is the critical time for safety; from this time until the load clears the aircraft most serious accidents occur.

e. Repeat Step b, above.

f. During release, extraction and deployment, note hazards to personnel from cables, straps, etc., as the load leaves the aircraft.

NOTE: All personnel will be wearing parachutes during period ramp door is open and this must be considered in evaluating both safety and human factors data.

g. If the load fails to extract because of a blown parachute, or locked mechanism, note the hazards involved in the following:

- 1) Securing the load with cables, chains or straps.
- 2) Winching the load back to the aircraft's CG storage point.
- 3) Cutting the parachute(s) free from load.
- 4) Closing cargo doors.

h. After the airdrop, note any equipment degradation which may present a hazard to personnel.

i. Repeat Step b, above.

6.2.4 Safety Measures Required on Drop Zone (Land and Water)

This subtest pertains to the safety measures required on the drop zone. Consideration should be given to 1) the emplacement of personnel, vehicles and equipment which will afford the greatest recovery capability with the minimum safety risk; 2) safety measures required in recovering, handling, and transporting the airdropped item.

The following procedures indicate the general method of establishing a drop zone, and recovering airdropped items.

6.2.4.1 Drop Zone, Land, Personnel and Non-Explosive Materiel

a. Select a drop zone location which can best support the ground tactical plan and affords maximum safety features:

- 1) Minimum number of obstacles in the area.
- 2) Access to the area by recovery and emergency vehicles.
- 3) Availability of adequate aircraft approach and departure routes.

b. Compute the required length of the drop zone:

$$D = RT$$

where D = zone length in meters

R = ground speed (rate) of aircraft in meters/sec

T = time required for aircraft to release its cargo

correcting

R = aircraft indicated airspeed \pm prevailing winds over drop zone

c. Determine how much of load can be released in each pass.

MTP 7-2-506
15 February 1972

- d. Set out a ground target indicating the desired point of impact. Target can be cross or circular in shape, at least 10' x 10' area. Drop zone may also be designated by a code letter to identify a specific DZ where multiple drops are being made.
- e. Emplace recovery and emergency vehicles around the perimeter of the drop zone in position to move into drop zone rapidly.
- f. Take wind speed and direction measurements at ground level. A handheld windmeter is usually accurate enough for these measurements.
- g. Establish communications between the drop zone radio operator/recovery NCO, the aircraft, and all recovery and emergency vehicles on established radio frequencies.
- h. Note the configuration of the drop zone and describe any safety hazards observed.
- i. A simulated flight referred to as a "dry run" will be conducted to orient crew and ground personnel to drop zone, procedure and approximate drop location.
- j. As aircraft approaches drop zone activate a smoke grenade and place in a can or barrel to generate billows of smoke, to indicate wind direction to the aircraft. Smoke should stop prior to actual drop so the drop will not be obscured.
- k. During the airdrops the airdrop officer/cargo master should be advised of changes in windspeed and direction, and the need to correct jump or release points.
- l. After the airdrop pick up personnel as quickly as possible. Inspect materiel loads to detect any hazardous conditions. Tag all parachutes with ATD drop number and test project number.
- m. Inspect suspension slings to determine if they are able to lift the load when the crane lifts the load onto the recovery vehicles. Replace any damaged suspension slings.
- n. Lift load onto recovery vehicle. Secure load to vehicle and transport to storage area. Transport parachutes to inspection and repack shop.
- o. Advise airdrop officer on status of recovery operation.
- p. Secure drop zone, removing any used and dangerous items. Make a final inspection of drop zone after recovery and emergency vehicles have cleared area.
- q. Note any safety hazards observed.

6.2.4.2 Drop Zone, Land, Explosive Material

- a. Repeat Steps a. through q. above. Additionally,
 - 1) Barricade all main access roads entering the drop zone with "Restricted Area" signs.
 - 2) Determine a safe perimeter in case of accidental detonation of explosives and ensure all personnel and vehicles are behind that perimeter.
 - 3) Ensure drop zone is clear of unauthorized personnel.
 - 4) Ensure that a munition destroyer crew with full equipment is at the drop zone.

MTP 7-2-506
15 February 1972

b. During the drop, watch for signs of explosive activation and notify the airdrop officer if there is a problem.

c. During and after the airdrop a qualified Explosive Ordnance Disposal (EOD) supervisor should:

- 1) Observe the airdropped load from a remote point through field glasses to determine if there is any indication of explosive activation, i.e., smoke, evidence of heat or severe damage to containers.
- 2) Upon evidence of possible activation or damage to containers the drop zone area will be secured for a minimum of 24 hours from the time the last load lands.
- 3) Inspect the loads from a safe distance marking potentially explosive loads with a yellow flag.
- 4) Remove parachutes and clear area of safe ammunition.
- 5) Destroy in place hazardous ammunition in accordance with appropriate SOP.
- 6) Transport safe ammunition to an open temporary storage area and conduct a post drop inspection.

d. Note any safety hazards observed.

6.2.4.3 Drop Zone, Water, Personnel and All Materiel

a. The same general procedure described above apply for airdrop over water. The difference being the method of recovery, where fast recovery craft (ships, boats, hovercraft, etc.) are used to rescue personnel or pick up materiel. The notable exceptions in this test are:

- 1) Enough powered water craft should be deployed around the drop zone that personnel can be picked up immediately after impact.
- 2) Explosive items cannot be monitored for 24 hours and should be destroyed if their condition is questionable.
- 3) Emergency facilities will have to be expanded to include items peculiar to waterdrop operations, i.e., respirators, dry clothes, portable heating units, etc.

b. Note any safety hazards observed.

NOTE: Portable lighting equipment may be required to illuminate the drop zone and surrounding area during night drops.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Indoctrination

Record the following:

MTP 7-2-506
15 February 1972

- a. Methods used for training test personnel.
- b. Methods used to evaluate technical manuals.
- c. Evidence that test personnel are sufficiently knowledgeable in test objectives and procedures.
- d. Precautionary measures developed from review of the Safety Statement.
- e. Basic plan for observing equipment operation and recording safety hazards.

6.3.1.2 Receiving Inspection

Record the following:

- a. Completeness of test item.
- b. Physical condition (photograph to show shipping damage).
- c. Test item - name, model number, manufacturer, serial number, etc.

6.3.2 Test Conduct

6.3.2.1 Mechanical and Electrical Hazards

a. Answers to questionnaires - each question will be checked "yes" or "no", or "not applicable". If "no" is checked, this indicates a hazard. The following actions must be taken:

- 1) The hazard will be categorized in accordance with Appendix B and the category entered in the "CAT" column of the questionnaire.
- 2) The hazard will be described in a test log or on a separate data sheet. The degree of detail will depend on the severity of the hazard. Photographs should be taken, as appropriate.

b. Any hazard encountered during conjunctive engineering tests should be recorded as in a.1), and a.2), above.

6.3.2.2 Personnel Safeguards

a. The same data is required as in 6.3.2.1.a and b, above.
b. Data should be provided on unusual personnel hazards, e.g., deceleration and acceleration forces may cause personnel to fall during the extraction phase of the airdrop. Data on location of personnel and safeguards available on the aircraft should be described in the test data reports. Photographs should be used to supplement these reports.

6.3.2.3 Safety Procedures Required on the Drop Zone (Land and Water)

a. Provide a description, supplemented with photographs, of the drop zone prior to the airdrop.
b. Record the following:

- 1) Number and type of vehicles used.

MTP 7-2-506
15 February 1972

- 2) Location of vehicles prior to drop and deployment of vehicles during drop.
- 3) Personnel assigned, their MOS, experience, and assignments at drop zone.
- 4) Method for recovery of personnel, non-explosive materiel, and explosive materiel.
- 5) Safety hazards (of any nature) during recovery of air-dropped loads.
- 6) Comments from personnel at drop zone on ways to improve safety procedures for recovery handling and disposition of airdropped materiel.

6.4 DATA REDUCTION AND PRESENTATION

6.4.1 Data Reduction

a. Summarize all data, categorizing the data as shown in Appendix B. Photographs should be annotated and correlated with summarized data and the test log or other supplementary reports. The data may be related to pertinent information from the following MTP's:

- 1) MTP 6-2-502, Human Factors Engineering
- 2) MTP 7-2-100, Tie-down Cargo Aircraft
- 3) MTP 7-2-510, Airdrop System Components

b. All data should be marked for identification including date, test number, correlation with other data, responsible test officer (his location and method of contacting him), etc.

6.4.2 Data Presentation

a. The main output of the data analysis will be a recommendation to HQ TECOM as to the issuance of a Safety Release. The Safety Release authorizes starting active service test operations. The recommendation for the Safety Release should also suggest any exceptions, special instructions, or other safety instructions for inclusion in the Safety Release.

b. Safety analysis of hazardous conditions of the type of equipment described in this MTP is basically a qualitative matter. Therefore, conclusions and recommendations will be somewhat subjective in nature. It is difficult to formulate specific mathematical methods for rating a test item as to safety. Nevertheless, guidelines can be established and the system of "hazard level categories" will facilitate the safety evaluation to some extent.

c. Analysis Guidelines

- 1) The identification of any Category IV (Catastrophic) hazard should leave the suitability of the item in serious question. Unless the hazard can be brought under control, or the need for the item is very urgent, the item should be rejected from a safety standpoint.
- 2) The presence of a Category III (Critical) hazard should also

MTP 7-2-506
15 February 1972

leave the suitability of the item in doubt. However, it might be easy to control or urgent need for the item might more easily justify approval. However, if several Category III hazards are present, the item probably should be rejected from a safety standpoint.

- 3) The presence of Category II (Marginal) hazards normally would not justify rejection of the item. However, all Category II hazards should be controlled and a large number of these hazards might lead to rejection of the item from a safety standpoint if the need for it were not critical.
- 4) Category I (Negligible) hazards can generally be tolerated. However, a large number of them is indicative of a lack of safety consciousness on the part of the developer. Although the item should not be rejected for Category I hazards; all should be corrected or controlled if at all possible.

APPENDIX A

AIRDROP SYSTEM SAFETY

1. Permanently Installed Airdrop Equipment

The following is a description of permanently installed airdrop equipment utilized in various aircraft.

a. Tiedown Devices - Tiedown provisions/fittings are usually set in a symmetrical pattern recessed in the cargo compartment floor. These fittings may have a strength capacity ranging from 1250 to 25,000 pounds. The airplane is also equipped with a number of tiedown devices to apply restraint to the airdrop loads. The following types of tiedown devices are currently in use:

- 1) D-1 Tiedown is rated at 25,000 pounds capacity. On one end of the tiedown a fitting attaches to the cargo floor tiedown fitting. On the other end is a slot which any chain link may be inserted. The chain is drawn tight by adjusting the turnbuckle.
- 2) MB-2 Tiedown is rated at 25,000 pounds and is similar to the D-1 except for a hook instead of jaws to attach to the tiedown fitting, and a quick release which permits detachment from the load regardless of chain tension.
- 3) C-2 Tiedown has a 10,000 pound rated capacity, and is similar in operation to the D-1, but is smaller and lighter.
- 4) MB-1 Tiedown has a rated capacity of 10,000 pounds and is similar to the MB-2. They are used for all restraint in which 10,000 pound capacity fittings can be used to restrain airdrop loads.
- 5) A-1A Tiedown is rated at 1,250 pounds and consists of a strap on which there are one stationary hook and one moveable hook. The stationary hook attaches to the cargo floor tiedown fitting. The strap is passed around a part of the load and the hood on the other side of the strap is attached to another tiedown fitting.
- 6) MC-1 Tiedown is rated at 5,000 pounds and is similar to A-1A except it has a pretension lever to aid in tightening the strap.
- 7) Type CGU-1/B Tiedown is a 20 foot long nylon web strap assembly rated at 5,000 pounds. It is equipped with a ratchet hook at one end with a handle that rotates 60 degrees per ratchet, and moves 120 degrees to release the spool for letting out webbing.
- 8) A-2 Cargo Net is rated at 10,000 pounds. It is used to secure small items of cargo, such as crates or boxes that do not have attachment points to which tiedown hooks can be applied. The ring sides of the net are secured to the cargo area floor or to platforms by passing a tiedown through the rings.

b. Pendulum Release System - is mounted and used to suspend the extraction chute; a pivot arm; a manual cocking cable for the bomb rack, and an electric release system which is used for normal release of the extraction chute from the bomb rack and a manual emergency release cable.

c. Static Line Anchor Cable System - provides for attaching and restraining the static lines during an airdrop. The system includes static line anchor cables, which are held in place by means of forward and aft supports.

d. Static Line Retrievers - consist of a winch, forward retriever cable assembly, and aft retriever cable assembly for both right and left sides of the airplane. The forward switches control both wind and unwind operations of the winches, the aft switches control only the rewind. Retriever cable assemblies pull the extracted static lines back into the airplane after an airdrop.

e. Roller Conveyors - skate wheel and buffer board cargo handling system-roller conveyors are assembled from sections of skate-wheel conveyors either 8 or 10 feet long and 1 foot wide. Two or three sections are normally bolted side by side to form a double or triple section. Buffer boards constructed of wood or metal are mounted on each side of the cargo floor aft end and have fittings to attach them to mating fittings on the airplane. The buffer boards prevent the loads from getting caught on its way out of the airplane.

f. Dual Rail Cargo Handling System - is essentially a roller conveyor which encompasses locking and release mechanisms for securing and/or releasing pallets and modular platforms. It consists of conveyor frame assemblies, and extension rails. The conveyor frame is mounted on both outboard sides of the airplane cargo floor and ramp. The extension rails are mounted on the cargo floor and bridge the cargo floor conveyor frame assemblies to the ramp conveyors. The intermediate conveyors are mounted on the cargo floor and ramp, and are centered between the conveyor frame assemblies.

g. Forward Buffer Assemblies - are L-shaped brackets, braces or clamps which are bolted to the conveyors just forward of the load to prevent forward movement of the cargo after all other restraints have been removed.

h. Power Plants - required for public address system, lights, and various solenoid valves and signal lights in the cargo door and ramp control systems and for winches. If the main power plants of the airplane are operating, 28VDC will be supplied by the main generators or by transformer - rectifier units. However, since the main power plants will not usually be running while loading is going on, current for loading operations are normally supplied by an external power source or the generator operated by the air turbine motor.

- 1) Some airplanes have a missile support system to supply a source of constant 115/200 - volt, 3-phase power.
- 2) Public Address System - consists of loudspeakers, microphones, plug in points and headsets.
- 3) Cargo Compartment Lights - consists of floor lights along each side of the cargo compartment; dome lights mounted throughout the cargo compartment, cargo door loading lights mounted inside of the cargo door, ramp loading lights mounted overhead above the forward edge of the ramp, jump platform lights just forward of each paratroop door and utility lights mounted under the flight station to illuminate stowage space.
- 4) Control Warning and Warning Panels - consist of air system control panel, jump signal control panel, door warning lights, alarm bells, etc.

5) Winches - installed and portable units.

- i. Hydraulic Systems - include cargo door and ramp controls, cargo door downlock and uplock and the pressure release valve.

2. General Guidance to Test Personnel

a. Systems Safety Engineering

System Safety Engineering is closely integrated with several other technical disciplines. Human Factors for example are so closely linked to safety that the evaluation of safety and human factors are often accomplished simultaneously. Any design that is operationally undesirable from a human factors' standpoint will certainly directly or indirectly contribute to a safety hazard. The same is true of maintainability and reliability engineering. Therefore the evaluation of systems' safety should be an integral part of every operational and maintenance test.

b. Safety Engineering Objectives

Safety Engineering programs are designed to assure:

- 1) Maximum safety consistent with operational requirements has been designed into the system and individual equipment.
- 2) Adequate controls over known hazards, inherent to the product are established to protect personnel and equipment.
- 3) Minimum risk is involved in the acceptance of new materials.
- 4) Hazards associated with each system are identified and corrected.
- 5) Retrofit actions (and resultant costs) to eliminate hazards are reduced.

3. Evaluation of Airdrop System Safety

The test criteria for airdrop system safety is directed at an evaluation of:

- a. Mechanical hazards - absence of sharp edges, adequacy of stowage and tiedown equipment, extraction, force transducers, and deployment systems.
- b. Electrical/Electronic hazards - activation of components by outside signals, protection of personnel from shock, adequate grounding, etc.
- c. Personnel safeguards - protection from tripping and falling inside the aircraft, or out of the aircraft, etc.
- d. Safety measures required on the drop zone, include establishment of a safe drop zone area, and methods for safe recovery, handling and transport of airdropped items.

4. Safety Statement and Release

- a. The Safety Statement is a summary of the data collected and evaluated during design and development phase, which expresses the opinion of the developing agency regarding the hazards and safety limitations that are

presented by the materiel, together with recommended actions to minimize these hazards and to reduce the exposure of personnel.

b. The Safety Release is a summary of safety data collected during the Engineering Test phase which expresses the specific hazards of components or systems, together with the operational limitations and actions necessary to protect service personnel from exposure to hazards. The safety release is a prerequisite for service test.

APPENDIX B

HAZARD LEVELS

The following table should be used to determine the level of safety hazard for any question checked "no" on the standard safety questionnaire. Definitions are taken from MIL-STD-882.

CATEGORY	LEVEL	CRITERION
I	NEGLIGIBLE	Will not result in personnel injury or system damage.
II	MARGINAL	Can be counteracted or controlled without injury to personnel or major system damage.
III	CRITICAL	Will cause personnel injury or major system damage, or will require immediate corrective action for personnel or system survival.
IV	CATASTROPHIC	Will cause death or severe injury to personnel or system loss.

APPENDIX C

STANDARD QUESTIONNAIRE

QUESTION	YES	NO	CAT.	N/A
1. If equipment must be installed in aircraft are appropriate lifting handles, eyes and rings provided? 2. Are lifting fixtures properly located with regard to equipment centers of gravity? 3. Is equipment designed to allow proper clearance for working personnel during installation? 4. Is equipment free of sharp corners or projections particularly at eye level and head level? 5. Are projections designed so as not to catch clothing? 6. Are control handles, levers, etc. designed so that they cannot be inadvertently operated by clothing or other equipment? 7. Are heavy, movable components designed so they can be secured or tied down during flight? 8. Is clearance provided for operating personnel wearing parachutes and breathing apparatus as necessary? 9. Does equipment allow room for operating personnel to stand clear and away from open aircraft doors during separation from the aircraft? 10. Are safety devices properly adjusted and operating 11. Are emergency devices (release, brakes, etc.) within easy reach of operating personnel 11a. Can safety or emergency devices be easily operated by personnel wearing gloves?				

QUESTION	YES	NO	CAT.	N/A
12. Are visual alarms located so as to attract the attention of operating personnel and are they sufficiently contrasted with their backgrounds?				
13. Are audio alarms, if provided, loud enough to be heard above aircraft sound levels?				
14. Are all installed components firmly attached to the aircraft?				
15. Are all installed components attached to aircraft structural members of sufficient strength?				
16. Does any component inflict undue stress to the aircraft structure during operation?				
17. Is there proper clearance between moving parts and personnel or aircraft structure during operation?				
18. Do floor surfaces, steps and platforms provide proper non-slip characteristics?				
19. Are all "losable" items attached with safety chains or lanyards?				
20. Is it obvious which items should be locked, fastened, or stored during operation?				
21. Are specific places and attachments provided for all items which must be stored?				
22. If pressurized vessels are used, are they provided with proper safety/relief valves or controls?				
23. Are handholds, steps, ladders and rails provided where necessary?				
24. Are dangerous moving parts (trip levers, gears, cams, etc.) either placed far enough away from personnel during operation or protected by safety covers?				

QUESTION	YES	NO	CAT.	N/A
25. Are pyrotechnic devices protected from inadvertent detonation by heat, electromagnetic radiation, sharp blows, etc. ?				
26. Are personnel and aircraft structure sufficiently protected from pyrotechnic devices?				
27. If heat is generated during operation, are personnel and flammable objects protected?				
28. Are all components sufficiently rugged and strong?				
29. Are all hazards properly covered in instruction manual?				
30. Are working areas properly lighted both for daylight and nighttime operation?				
31. Where appropriate, does equipment provide proper torque limiting devices, detents, quick release mechanisms, safety trips, positive stops or other safety devices?				
32. Is it evident when a cover is in place but not secured?				
33. Is equipment free of projection at foot and ankle level which could trip personnel, particularly near open aircraft doors?				
34. Are weight distribution and handles such that equipment can be easily moved by personnel wearing parachutes and breathing apparatus?				
35. Where fragile or easily bent components are used, are they adequately protected?				
The following questions may be omitted if the test item contains no electrical or electronic components.				
36. If equipment uses over 30 volts AC or DC, are all electrical components, wires, chassis, etc. protected by suitable insulated covers?				
37. If equipment is permanently installed in aircraft, is it suitably grounded to the aircraft structure?				

QUESTION	YES	NO	CAT.	N/A
38. Are ground attachments sturdy enough to withstand normal use?				
39. Are ground attachments of large enough gage to prevent dangerous potential buildup?				
40. If equipment is designed for use on the ground is adequate shock protection provided for operating personnel?				
41. Is device provided with suitable circuit breakers or fuses?				
42. Are power connections adequately marked as to voltage, frequency, AC or DC, polarity, amperage and/or wattage?				
43. Are interconnecting units and cables provided with keyed connectors or other devices to prevent wrong connections?				
44. Are all power connections wired so that the female component is on the "hot" or power side and the male component is on the "cold" or equipment side?				
45. Can all controls, especially power and safety switches, be easily operated by personnel with or without gloves?				
46. Are all controls located so as to protect the operator from dangerous voltage?				
47. Are all controls arranged and marked so as to make inadvertent operation of them improbable?				
48. Are wires and cables adequately protected from contact with metal or wear to insure insulation?				
49. Is adequate ventilation provided; is excessive heat generated during operation?				

QUESTION	YES	NO	CAT.	N/A
50. Are warning devices adequate, conforming to questions 11 and 12, above?				
51. Has equipment been subjected to explosive, rain, humidity and heat tests as appropriate?				